

METHOD AND APPARATUS FOR MANUFACTURING
IMAGE DISPLAYING APPARATUS

BACKGROUND OF THE INVENTION

5 Field of the Invention

The present invention relates to an image
displaying apparatus in which electron-emitting devices
are arranged in matrix, more particularly to a method
and an apparatus for manufacturing an image displaying
10 apparatus having a display panel on which a rear plate
(RP) provided with electron-emitting devices arranged
in matrix and a face plate (FP) provided with phosphors
are arranged in opposing positions as a first image
forming member and as a second image forming member,
15 respectively.

Related Background Art

Conventionally, an electron-emitting device is
roughly divided into two known types, i.e., a thermal
electron-emitting device and a cold-cathode electron-
20 emitting device. The cold-cathode electron-emitting
device includes the field emission type (hereinafter
referred to as the FE type), the metal/insulation
layer/metal type (hereinafter referred to the MIM
type), the surface conducting type electron-emission
25 device, and the like.

As an example of the FE type, an electron-emission
device disclosed in W. P. Dyke & W. W. Dolan, "Field

Emission", Advance in Electron Physics, 8, 89 (1956),
C. A. spindt, "PHYSICAL Properties of thin-film field
emission cathodes with molybdenum cones", J. Appl.
Phys., 47, 5248 (1976), or the like is known.

5 As an example of the MIM type, an electron-
emission device disclosed in C. A. Mead, "Operation of
Tunnel-Emission Devices", J. Appl. Phys., 32, 646
(1961) or the like is known.

10 As an example of the surface conducting type
electron-emission device type, an electron-emission
device disclosed in M. I. Elinson, Radio Eng. Electron
Phys., 10, 1290 (1965) or the like is known.

15 A surface conducting type electron-emission device
is to utilize a phenomenon that generates electron
emission by flowing electric current to a thin film
with a small area formed on a substrate in parallel
with the surface of the film. As the surface
conducting type electron-emission device, one using an
SnO₂ thin film by Elinson, et al. mentioned above, one
20 using an Au thin film [G. Dittmer: "Thin Solid Films,"
9, 317 (1972)], one using an In₂O₃/SnO₂ thin film [M.
Hartwell and C. G. Fonstad: "IEEE Trans. ED Conf.", 519
(1975)], one using a carbon thin film [Araki Hisashi,
et al.: Shinku, Vol. 26, No. 1, page 22 (1983)] and the
25 like are known.

For the manufacture of an image displaying
apparatus using the above-mentioned electron-emitting

device, a process for manufacturing a display panel is used which comprises the steps of: preparing an electron source substrate on which such electron-emitting devices are arranged in matrix as an RP and
5 preparing a phosphor substrate to be an FP provided with phosphors that emit light due to excitation by an electron beam; disposing the FP and the RP in opposing positions by disposing a spacer providing an envelope and an anti-atmospheric pressure structure such that
10 the electron-emitting elements and the phosphors will be inside and; sealing the inside using a low-melting point material such as frit glass, indium or the like as a sealing material; and sealing off a vacuum exhaust pipe provided in advance after vacuum exhausting the
15 inside from the vacuum exhaust pipe.

The manufacturing method according to the conventional art described above requires considerably long time for manufacturing one display panel, thus is not suitable for manufacturing a display panel inside
20 of which requires the vacuum degree of 1×10^{-6} Pa or more.

The drawback of this conventional art was solved by a method described, for example, in the Japanese Patent Application Laid-open No. 11-135018.

25 In the method described in the Japanese Patent Application Laid-open No. 11-135018, since only a step of sealing two substrates after positioning an FP and

an RP in a single vacuum chamber is used, the above-mentioned other steps such as bake processing, getter processing, electron beam clean processing and the like that are necessary for preparing a display panel needs
5 to be applied in the single vacuum chamber respectively. In addition, since movements of the FP and the RP between vacuum chambers are performed upon loosing evacuated state into non-vacuum state, each vacuum chamber is evacuated every time when an FP and
10 an RP are carried therein. Due to these reasons, manufacturing process time is long. Therefore, considerable reduction of manufacturing process time has been required, and at the same time, it has been required to attain high vacuum degree of 1×10^{-6} Pa or
15 more in a display panel during a final manufacturing step in a short time.

SUMMARY OF THE INVENTION

It is an object of the present invention to enable
20 to easily attain reduction of vacuum exhaust time and high vacuum degree in manufacturing an image displaying apparatus, thereby improving efficiency of manufacturing.

According to one aspect of the present invention,
25 a method of manufacturing an image displaying apparatus comprising the steps of:

a: preparing a first substrate on which phosphor

exciting means is disposed and a second substrate on which phosphors emitting light by the phosphor exciting means under the vacuum atmosphere;

5 b: carrying one or both of the first and the second substrates into a getter processing chamber in the vacuum atmosphere under the vacuum atmosphere, and subjecting to getter processing the one substrate carried or one or both of the substrates carried; and

10 c: carrying the first and the second substrates in a seal processing chamber in the vacuum atmosphere under the vacuum atmosphere, and heat sealing the substrates in an opposing state is provided.

15 According to another aspect of the present invention, a method of manufacturing an image displaying apparatus comprising the steps of:

 a: preparing a first substrate on which phosphor exciting means is disposed and a second substrate on which phosphors emitting light by the phosphor exciting means under the vacuum atmosphere;

20 b: carrying the first and the second substrates into a bake processing chamber in the vacuum atmosphere under the vacuum atmosphere and subjecting to bake processing both the substrates at predetermined temperature; and

25 c: carrying the first and the second substrates in a seal processing chamber in the vacuum atmosphere under the vacuum atmosphere, and heat sealing the

substrates in an opposing state is provided.

According to a still another aspect of the present invention, an apparatus for manufacturing an image displaying apparatus comprising:

5 a: a conveying means for conveying a first substrate provided with a first member for an image displaying apparatus and a second substrate provided with a second member for an image displaying apparatus;

10 b: a first vacuum chamber in which one or both of the first and the second substrates can be carried under the vacuum atmosphere by the conveying means;

 c: getter giving means, arranged in the first vacuum chamber, having a getter precursor and getter activating means for activating the getter precursor;

15 d: a second vacuum chamber in which the first and the second substrates can be carried in under the vacuum atmosphere by the conveying means;

20 e: substrate arranging means, arranged in the second vacuum chamber toward inside, for arranging the first and the second substrates in positions opposite to each other by orienting the first and the second members for an image displaying apparatus toward inside; and

25 f: sealing means, arranged in the second vacuum chamber, for heat sealing the first and the second substrates arranged in opposing positions by the substrate arranging means at predetermined temperature

is provided.

According to a further aspect of the present invention, an apparatus for manufacturing an image displaying apparatus comprising:

5 a: a conveying means for conveying a first substrate provided with a first member for an image displaying apparatus and a second substrate provided with a second member for an image displaying apparatus;

10 b: a first vacuum chamber in which the first and the second substrates can be carried under the vacuum atmosphere by the conveying means;

15 c: baking means, arranged in the first vacuum chamber, for bake processing the carried first and the second substrates by heating the first and second substrates and;

 d: a second vacuum chamber in which the first and the second substrates can be carried under the vacuum atmosphere by the conveying means;

20 e: substrate arranging means, arranged in the second vacuum chamber, for arranging the first and the second substrates in positions opposite to each other by orienting the first and the second members for an image displaying apparatus toward inside; and

25 f: sealing means, arranged in the second vacuum chamber, for heat sealing the first and the second substrates arranged in opposing positions by the substrate arranging means at predetermined temperature

is provided.

BRIEF DESCRIPTION OF THE DRAWINGS

5 Figs. 1A, 1B and 1C are schematic cross-sectional views of an apparatus according to a one example of the present invention;

Fig. 2 is a schematic plan view of an apparatus according to an another example of the present invention; and

10 Fig. 3 is a cross-sectional view of an image displaying apparatus that is manufactured according to an apparatus and a method of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

15 First, the present invention is a method of manufacturing an image displaying apparatus, which is characterized by comprising the steps of:

a: preparing a first substrate on which phosphor exciting means is disposed and a second substrate on
20 which phosphors emitting light by the phosphor exciting means under the vacuum atmosphere;

b: carrying one or both of the first and the second substrates into a getter processing chamber in the vacuum atmosphere under the vacuum atmosphere, and
25 subjecting to getter processing the one substrate carried or one or both of the substrates carried; and

c: carrying the first and the second substrates in

a seal processing chamber in the vacuum atmosphere under the vacuum atmosphere, and heat sealing the substrates in an opposing state.

5 Secondly, the present invention is a method of manufacturing an image displaying apparatus, which is characterized by comprising the steps of:

10 a: preparing a first substrate on which phosphor exciting means is disposed and a second substrate on which phosphors emitting light by the phosphor exciting means under the vacuum atmosphere;

15 b: carrying the first and the second substrates into a bake processing chamber in the vacuum atmosphere under the vacuum atmosphere and subjecting to bake processing both the substrates at predetermined temperature; and

c: carrying the first and the second substrates in a seal processing chamber in the vacuum atmosphere under the vacuum atmosphere, and heat sealing the substrates in an opposing state.

20 Thirdly, the present invention is a method of manufacturing an image displaying apparatus, which is characterized by comprising the steps of:

25 a: preparing a first substrate on which phosphor exciting means is disposed and a second substrate on which phosphors emitting light by the phosphor exciting means under the vacuum atmosphere;

b: carrying the first and the second substrates

into a bake processing chamber in the vacuum atmosphere under the vacuum atmosphere, and subjecting to bake processing both the substrates at predetermined temperature;

5 c: carrying one or both of the first and the second substrates into a getter processing chamber in the vacuum atmosphere under the vacuum atmosphere, and getter processing the carried one substrate or one or both of the carried substrates; and

10 d: carrying the first and the second substrates in a seal processing chamber in the vacuum atmosphere under the vacuum atmosphere, and heat sealing the substrates in an opposing state.

 Fourthly, the present invention is a method of
15 manufacturing an image displaying apparatus, which is characterized by comprising the steps of:

 a: preparing a first substrate on which phosphor
 exciting means is disposed and a second substrate on
 which phosphors emitting light by the phosphor exciting
20 means under the vacuum atmosphere;

 b: carrying the first and the second substrates
 into a bake processing chamber in the vacuum atmosphere
 under the vacuum atmosphere and subjecting to bake
 processing both the substrates at predetermined
25 temperature;

 c: carrying one or both of the first and the second substrates into a first getter processing

chamber in the vacuum atmosphere under the vacuum atmosphere, and first getter processing the carried one substrate or one or both of the carried substrates;

5 d: carrying one or both of the first and the second substrates into an electron beam clean processing chamber in the vacuum atmosphere under the vacuum atmosphere, and electron beam clean processing the carried one substrate or one or both of the carried substrates;

10 e: carrying one or both of the first and the second substrates into a second getter processing chamber in the vacuum atmosphere under the vacuum atmosphere, and second getter processing the carried one substrate or one or both of the carried substrates;
15 and

f: carrying the first and the second substrates into a seal processing chamber in the vacuum atmosphere under the vacuum atmosphere, and heat sealing the substrates in an opposing state.

20 Fifthly, the present invention is an apparatus for manufacturing an image displaying apparatus, which is characterized by comprising:

a: a conveying means for conveying a first substrate provided with a first member for an image
25 displaying apparatus and a second substrate provided with a second member for an image displaying apparatus;

b: a first vacuum chamber in which one or both of

the first and the second substrates can be carried under the vacuum atmosphere by the conveying means;

c: getter giving means arranged in the first vacuum chamber having a getter precursor and getter
5 activating means for activating the getter precursor;

d: a second vacuum chamber in which the first and the second substrates can be carried under the vacuum atmosphere by the conveying means;

e: substrate arranging means, arranged in the
10 second vacuum chamber toward inside, for arranging the first and the second substrates in positions opposite to each other by orienting the first and the second members for an image displaying apparatus toward inside; and

f: sealing means, arranged in the second vacuum chamber, for heat sealing the first and the second substrates arranged in opposing positions by the substrate arranging means at predetermined temperature.
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Sixthly, the present invention is an apparatus for manufacturing an image displaying apparatus, which is
20 characterized by comprising:

a: a conveying means for conveying a first substrate provided with a first member for an image displaying apparatus and a second substrate provided
25 with a second member for an image displaying apparatus;

b: a first vacuum chamber in which the first and the second substrates can be carried under the vacuum

atmosphere by the conveying means;

c: baking means, arranged in the first vacuum chamber, for bake processing the carried first and the second substrates by heating the first and second
5 substrates;

d: a second vacuum chamber in which the first and the second substrates can be carried under the vacuum atmosphere by the conveying means;

e: substrate arranging means, arranged in the
10 second vacuum chamber, for arranging the first and the second substrates in positions opposite to each other by orienting the first and the second members for an image displaying apparatus toward inside; and

f: sealing means, arranged in the second vacuum
15 chamber, for heat sealing the first and the second substrates arranged in opposing positions by the substrate arranging means at predetermined temperature.

Seventhly, the present invention is an apparatus for manufacturing an image displaying apparatus, which
20 is characterized by comprising:

a: a conveying means for conveying a first substrate provided with a first member for an image displaying apparatus and a second substrate provided with a second member for an image displaying apparatus;

25 b: a first vacuum chamber in which the first and the second substrates can be carried under the vacuum atmosphere by the conveying means;

c: baking means, arranged in the first vacuum chamber, for bake processing the carried first and the second substrates by heating the first and second substrates;

5 d: a second vacuum chamber in which the first and the second substrates can be carried under the vacuum atmosphere by the conveying means;

10 e: getter giving means arranged in the second vacuum chamber having a getter precursor and getter activating means for activating the getter precursor;

f: a third vacuum chamber in which the first and the second substrates can be carried under the vacuum atmosphere by the conveying means;

15 g: substrate arranging means, arranged in the third vacuum chamber, for arranging the first and the second substrates in positions opposite to each other by orienting the first and the second members for an image displaying apparatus toward inside; and

20 h: sealing means, arranged in the third vacuum chamber, for heat sealing the first and the second substrates arranged in opposing positions by the substrate arranging means at predetermined temperature.

25 Eighthly, the present invention is an apparatus for manufacturing an image displaying apparatus, which is characterized by comprising:

a: a conveying means for conveying a first substrate provided with a first member for an image

displaying apparatus and a second substrate provided with a second member for an image displaying apparatus;

b: a first vacuum chamber in which the first and the second substrates can be carried under the vacuum atmosphere by the conveying means;

c: baking means, arranged in the first vacuum chamber, for bake processing the carried first and the second substrates by heating the in first and second substrates;

d: a second vacuum chamber in which the first and the second substrates can be carried under the vacuum atmosphere by the conveying means;

e: getter giving means arranged in the second vacuum chamber having a getter precursor and getter activating means for activating the getter precursor;

f: a third vacuum chamber in which one or both of the first and the second substrates can be carried under the vacuum atmosphere by the conveying means;

g: electron beam cleaning means, arranged in the third vacuum chamber, for applying electron beam clean processing by irradiating electron beams;

h: a fourth vacuum chamber in which one or both of the first and the second substrates can be carried under the vacuum atmosphere by the conveying means;

i: second getter giving means arranged in the fourth vacuum chamber having a getter precursor and getter activating means for activating the getter

precursor;

j: a fifth vacuum chamber in which one or both of the first and the second substrates can be carried under the vacuum atmosphere by the conveying means;

5 k: substrate arranging means, arranged in the fifth vacuum chamber, for arranging the first and the second substrates in positions opposite to each other by orienting the first and the second members for an image displaying apparatus toward inside; and

10 l: sealing means, arranged in the fifth vacuum chamber, for heat sealing the first and the second substrates arranged in opposing positions by the substrate arranging means at predetermined temperature.

Ninthly, the present invention is an apparatus for
15 manufacturing an image displaying apparatus, characterized by comprising:

a: a conveying means for conveying a first substrate provided with a first member for an image displaying apparatus and a second substrate provided
20 with a second member for an image displaying apparatus;

b: a first decompression chamber in which the first substrate carried by the conveying means can be carried without being exposed to the atmosphere while maintaining a decompressed state;

25 c: getter giving means arranged in the first decompression chamber having a getter precursor and getter activating means for activating the getter

precursor;

d: a second decompression chamber, to which
getters are given, in which the first and the second
substrates can be carried without being exposed to the
5 atmosphere;

e: substrate arranging means, arranged in the
second decompression chamber, for arranging the first
and the second substrates in positions opposite to each
other by orienting the first and the second members for
10 an image displaying apparatus toward inside; and

f: sealing means, arranged in the second
decompression chamber, for sealing the first and the
second substrates arranged in opposing positions by the
substrate arranging means by heating the first and the
15 second substrates at predetermined temperature.

Tenthly, the present invention is an apparatus for
manufacturing an image displaying apparatus,
characterized by comprising:

a: a conveying means for conveying a first
20 substrate provided with a first member for an image
displaying apparatus and a second substrate provided
with a second member for an image displaying apparatus;

b: a first decompression chamber in which the
first and the second substrates carried in by the
25 conveying means can be carried without being exposed to
the atmosphere while maintaining a decompressed state;

c: getter giving means arranged in the first

decompression chamber having a getter precursor and
getter activating means for activating the getter
precursor;

5 d: a second decompression chamber in which the
first and the second substrates in the first
decompression chamber can be carried without being
exposed to the atmosphere;

10 e: substrate arranging means, arranged in the
second decompression chamber, for arranging the first
and the second substrates in positions opposite to each
other by orienting the first and the second members for
an image displaying apparatus toward inside; and

15 f: sealing means, arranged in the second
decompression chamber, for sealing the first and the
second substrates arranged in opposing positions by the
substrate arranging means by the first and the second
substrates at predetermined temperature.

Eleventh, the present invention is an apparatus
for manufacturing an image displaying apparatus, which
20 is characterized by comprising:

a: a conveying means for conveying a first
substrate provided with a first member for an image
displaying apparatus and a second substrate provided
with a second member for an image displaying apparatus;

25 b: a first decompression chamber in which the
first and the second substrates carried in by the
conveying means can be carried without being exposed to

the atmosphere while maintaining a decompressed state;

c: baking means, arranged in the first
decompression chamber, for bake processing the carried
first and the second substrates by heating the
5 substrates;

d: first getter giving means, arranged in the
first decompression chamber or a second decompression
chamber in which the first and the second substrates
can be carried from the first decompression chamber
10 without being exposed to the atmosphere, having a
getter precursor and getter activating means for
activating the getter precursor;

e: a third decompression chamber in which the
first and the second substrates can be carried from the
15 first or the second decompression chamber without being
exposed to the atmosphere;

f: substrate arranging means, arranged in the
third decompression chamber, for arranging the first
and the second substrates in positions opposite to each
20 other by orienting the first and the second members for
an image displaying apparatus toward inside; and

g: sealing means, arranged in the third
decompression chamber, for sealing the first and the
second substrates arranged in opposing positions by the
25 substrate arranging means by heating the first and the
second substrates at predetermined temperature.

Twelfth, the present invention is an apparatus for

manufacturing an image displaying apparatus, which is characterized by comprising:

5 a: a conveying means for conveying a first substrate provided with a first member for an image displaying apparatus and a second substrate provided with a second member for an image displaying apparatus;

10 b: a first decompression chamber in which the first and the second substrates carried in by the conveying means can be carried without being exposed to the atmosphere while maintaining a decompressed state;

c: baking means, arranged in the first decompression chamber, for bake processing the carried first and the second substrates by heating the substrates;

15 d: first getter giving means, arranged in the first decompression chamber or a second decompression chamber in which the first and the second substrates can be carried from the first decompression chamber without being exposed to the atmosphere, having a
20 getter precursor and getter activating means for activating the getter precursor;

e: a third decompression chamber in which the first and the second substrates can be carried from the first or the second decompression chamber without being
25 exposed to the atmosphere;

f: electron beam cleaning means, arranged in the third decompression chamber, for cleaning the first and

the second substrates by irradiating electron beams to the first and the second substrates;

g: a fourth decompression chamber in which the first and the second substrates can be carried from the third decompression chamber without being exposed to the atmosphere;

h: second getter giving means, arranged in the fourth decompression chamber, having a getter precursor and getter activating means for activating the getter precursor;

i: a fifth decompression chamber in which the first and the second substrates can be carried from the fourth decompression chamber without being exposed to the atmosphere;

j: substrate arranging means, arranged in the fifth decompression chamber, for arranging the first and the second substrates in positions opposite to each other by orienting the first and the second members for an image displaying apparatus toward inside; and

k: sealing means, arranged in the fifth decompression chamber, for sealing the first and the second substrates arranged in opposing positions by the substrate arranging means by heating the first and the second substrates at predetermined temperature.

In addition, the present invention includes the following features as its preferred aspects:

in the above-mentioned first and the second

aspects, the steps a, b and c are steps set on one line, and a heat shielding member formed of reflective metal or the like is disposed between the getter processing chamber and the seal processing chamber;

5 in the above-mentioned first and the second aspects, the steps a, b and c are steps set on one line, and a load lock is disposed between the getter processing chamber and the seal processing chamber;

10 in the above-mentioned first and the second aspects, the steps a, b and c are set on a star arrangement, and the getter processing chamber and the seal processing chamber are partitioned by an independent chamber;

15 in the above-mentioned third aspect, the steps a, b, c and d are steps set on one line, and a heat shielding material formed of reflective metal or the like is disposed between the bake processing chamber and the getter processing chamber, between the bake processing chamber and the seal processing chamber, or
20 between the bake processing chamber, the getter processing chamber and the seal processing chamber, respectively;

25 in the above-mentioned third aspect, the steps a, b, c and d are steps set on one line, and a load lock is disposed the bake processing chamber and the getter processing chamber, between the bake processing chamber and the seal processing chamber, or between the bake

processing chamber, the getter processing chamber and the seal processing chamber, respectively;

in the above-mentioned third aspect, the steps a, b, c and d are arranged on a star arrangement, and the
5 bake processing chamber, the getter processing chamber and the seal processing chamber are partitioned by an independent chamber;

in the above-mentioned fourth aspect, the steps a, b, c, d, e and f are steps set on one line, and a heat
10 shielding member formed of reflective metal or the like is disposed between the bake processing chamber and the first getter processing chamber, between the first
getter processing chamber and the electron beam clean processing chamber, between the electron beam clean
15 processing chamber, or between the second getter processing chamber and the seal processing chamber;

in the above-mentioned fourth aspect, the steps a, b, c, d, e and f are steps set on one line, and a load
lock is disposed between the bake processing chamber
20 and the first getter processing chamber, between the first getter processing chamber and the electron beam clean processing chamber, between the electron beam
clean processing chamber, or between the second getter processing chamber and the seal processing chamber;

in the above-mentioned fourth aspect, the steps a, b, c, d, e and f are set on a star arrangement, and the
25 bake processing chamber, the first getter processing

chamber, the electron beam clean processing chamber, the second getter processing chamber and the seal processing chamber are partitioned by independent chambers;

5 in the above-mentioned fifth and the sixth aspects, the first vacuum chamber and the second vacuum chamber are arranged on one line;

 in the above-mentioned fifth and the sixth aspects, the first vacuum chamber and the second vacuum
10 chamber are arranged on one line, and each chamber is partitioned by a heat shielding member formed of reflective metal;

 in the above-mentioned seventh aspect, the first vacuum chamber, the second vacuum chamber and the third
15 vacuum chamber are arranged on one line, and each chamber is partitioned by a heat shielding member formed of reflective metal or the like;

 in the above-mentioned seventh aspect, the first vacuum chamber, the second vacuum chamber and the third
20 vacuum chamber are arranged on one line, and each chamber is partitioned by a load lock;

 in the above-mentioned seventh aspect, the first vacuum chamber, the second vacuum chamber and the third
25 vacuum chamber are provided on a star arrangement, and each chamber is partitioned by an independent chamber;

 in the above-mentioned eighth aspect, the first vacuum chamber, the second vacuum chamber, the third

vacuum chamber, the fourth vacuum chamber and the fifth vacuum chamber are arranged on one line, and each chamber is partitioned by a heat shielding member formed of reflective metal or the like;

5 in the above-mentioned eighth aspect, the first vacuum chamber, the second vacuum chamber, the third vacuum chamber, the fourth vacuum chamber and the fifth vacuum chamber are arranged on one line, and each chamber is partitioned by a load lock; and

10 in the above-mentioned eighth aspect, the first vacuum chamber, the second vacuum chamber, the third vacuum chamber, the fourth vacuum chamber and the fifth vacuum chamber are provided on a star arrangement, and each chamber is partitioned by an independent chamber.

15 Moreover, in the above-mentioned ninth through twelfth aspects, the first through fifth decompression chambers contain inert gases such as an argon gas, a neon gas or the like, or a hydrogen gas under decompression. In addition, in the above-mentioned
20 ninth through twelfth aspects, the first member for an image displaying apparatus is a plasma generating device, and the second member for an image displaying apparatus is a phosphor or a color filter.

25 Fig. 1A schematically illustrates a manufacturing apparatus in accordance with the present invention, Fig. 1B shows a temperature profile in which a process temperature is indicated on a vertical axis with

respect to time on a horizontal axis, and Fig. 1C shows a vacuum degree profile in which a vacuum degree is indicated on a vertical axis with respect to time on a horizontal axis. On example of a manufacturing method and a manufacturing apparatus in accordance with the present invention will be hereinafter described with reference to these drawings.

In an apparatus illustrated in Fig. 1A, a front chamber 101, a bake processing chamber 102, a first step getter processing chamber 103, an electron beam clean processing chamber 104, a second getter processing chamber 105, a seal processing chamber 106 and a cool chamber 107 are serially arranged in a carrying direction (an arrow 127 in Fig. 1A), and an RP 111 and an FP 112 serially pass through each chamber in the arrow 127 direction by driving a carrying roller 109 and a carrying belt 108 and are applied various kinds of processing during the passage. That is, steps of preparation under the vacuum atmosphere in the front chamber 101, bake processing in the bake processing chamber 102, first getter processing in the first step getter processing chamber 103, cleaning by electron beam irradiation in the electron beam clean processing chamber 104, second getter processing in the second step getter processing chamber 105, heat sealing in the seal processing chamber 106 and cool processing in the cool chamber 107 are respectively performed on one

serial line.

Preferably, a heat shielding member 128 (in a plate form, a film form, etc.) formed of reflective metal reflecting radiative heat and an infrared ray such as aluminum, chromium and stainless steel is disposed between each chamber. The heat shielding member 128 may be disposed between chambers with different temperature profiles, for example, either between the bake processing chamber 102 and the first step getter processing chamber 103 or between the second step getter processing chamber 105 and the seal processing chamber 106 or optimally both, but may be disposed between each chamber. In addition, the heat shielding member 128 is disposed such that it does not hinder the FP 112 mounted on the carrying belt 108 and the RP 111 fixed on an elevating device when they move between each chamber.

A load lock 129 is disposed between the front chamber 101 and the bake processing chamber 102 illustrated in Fig. 1A. The load lock 129 is to open and close between the front chamber 101 and the bake processing chamber 102. In addition, a vacuum exhaust system 130 is connected to the front chamber 101 and a vacuum exhaust system 131 if connected to the bake processing chamber 102.

After carrying the RP 111 and the FP 112 in the front chamber 101, a carrying-in port 110 is shielded

and, at the same time, the load lock 129 is shielded, thereby vacuum exhausting inside the front chamber 101 by the vacuum exhaust system 130. During this operation, insides of all of the bake processing chamber 102, the first step getter processing chamber 103, the electron beam clean processing chamber 104, the second step getter processing chamber 105, the seal processing chamber 106 and the cool chamber 107 are vacuum exhausted by the vacuum exhaust system 131 to bring them in a vacuum exhausted state.

When the front chamber 101 and other chambers following the front chamber 101 has reached the vacuum exhausted state, the load lock 129 is opened, the RP 111 and the FP 112 are carried out of the front chamber 101 and carried in the bake processing chamber 102, the load lock 129 is shielded after completing carrying in the RP 111 and FP 112, then the carrying-in port 110 is opened, and another RP 111 and FP 112 are carried in the front chamber 101, thereby repeating the steps of vacuum exhausting inside of the front chamber 101 by the vacuum exhaust system 130.

In the present invention, it is preferable to dispose a load lock (not shown) identical with the load lock 129. A pump (evacuation exhaust system) is arranged in each of the chambers separated by a load lock. The load lock may be disposed between respective chambers, but it is preferable to dispose the load lock

between the chambers with different vacuum degree of a vacuum degree profile shown in Fig. 1C, for example, either between the bake processing chamber 102 and the first step getter processing chamber 103 or between the
5 electron beam clean processing chamber 104 and the second step getter processing chamber 105 or optimally both.

In the present invention, it is preferable to fixedly provide an envelope sealing a vacuum structure
10 and a spacer 115 forming an anti-atmosphere structure on the RP 111 in advance before carrying it in the front chamber 101. In a position corresponding to the envelope 113 of the FP 112, a sealing material 114 using low melting point material such as frit glass or
15 low melting point metal such as indium, or an alloy thereof may be provided. In addition, as illustrated, the sealing material 114 may be provided in the envelope 113.

Heat processing (bake processing) by a heating
20 plate 116 is applied to the RP 111 and the FP 112 carried in the bake processing chamber 102 without being exposed to the atmosphere in the bake processing chamber 102. By this bake processing, impurity gasses such as hydrogen gas, steam and oxygen contained in the
25 RP 111 and the FP 112 can be displaced. A bake processing temperature at this point is generally 300°C to 400°C, preferably 350°C to 380°C. A vacuum degree

at this point is approximately 1×10^{-4} Pa.

The RP 111 and the FP 112 completing the bake processing are carried in the first step getter processing chamber 103, the RP 111 is fixed on a holder 118 and moved the upper part of the chamber 103, a getter flash 120 of an evaporable getter material (e.g., a getter material made of barium, etc.) contained in a getter flash apparatus 119 is generated and activated with respect to the FP 112, thereby depositing a getter film (not shown) consisting of a barium film or the like on the surface of the FP 112. A film thickness of the first step getter at this point is generally 5 nm to 500 nm, preferably 10 nm to 100 nm, more preferably 20 nm to 50 nm. In addition, in the present invention, a getter film or a getter material consisting of a titanium material, an NEG material or the like may be provided on the RP 111 or the FP 112 in advance other than the above-mentioned getter material.

As the holder 118, an appliance that can be fixed by a force sufficient for the RP 111 not to drop, for example, an appliance utilizing an electrostatic chuck method or a mechanical chuck method may be used.

The RP 111 fixed on the holder 118 is elevated to a position sufficiently distant from the FP 112 on the conveying roller 108 by the elevating device 117. In elevating the RP 111, an interval between the RP 111

and the FP 112 is preferably an interval sufficient for
enlarging conductance between both the substrates,
although it depends on a size of a used vacuum chamber.
An interval between both the substrates is generally
5 sufficient if it is 50 mm or more.

In addition, in the above-mentioned step, if a
barium getter is used, a process temperature of the
first step getter processing chamber is set at
approximately 100°C. A vacuum degree then is 1×10^{-5}
10 Pa.

Although only the FP 112 is shown as being
irradiated the getter flash 120 in Fig. 1A, in the
present invention, it is also possible to give a getter
by irradiating a getter flash 120 similar to the above-
15 mentioned one to the RP 111 only or both of the RP 111
and the FP 112. In addition, the first getter flash
may be performed within the bake processing chamber 102
in order to increase vacuum degree of the vacuum
atmosphere during and after the bake processing in the
20 bake processing chamber 102.

Subsequently, when the RP 111 and the FP 112 are
carried in the electron beam clean processing chamber
104 without being exposed to the atmosphere, the RP 111
and/or the FP 112 is scanned with an electron beam 122
25 by an electron beam oscillator 121 in the electron beam
clean processing chamber 104, and particularly when
impurity gasses in the phosphor (not shown) of the FP

112 are displaced in carrying in the RP 111 and the FP 112, as an interval between the RP 111 held on the elevating device 117 and the FP 112 held on the conveying belt 108, the interval in the previous first
5 step getter processing step is preferably maintained without change.

Although only the FP 112 is shown as being applied the electron beam clean processing, in the present invention, it is also possible to apply electron beam
10 clean processing similar to the above-mentioned one to the RP 111 only or both of the RP 111 and the FP 112.

After the above-mentioned electron beam clean processing, the RP 111 and the FP 112 are carried in the second step getter processing chamber 105 without
15 being exposed to the atmosphere, thereby generating a getter flash 124 from the getter flash apparatus 123 by a method similar to that of the first step getter processing chamber 103 and giving getter to the FP 112. In giving getter to the FP 112, a film thickness of a
20 second step getter is generally 5 nm to 500 nm, preferably 10 nm to 100 nm, more preferably 20 nm to 50 nm. In carrying in the RP 111 and the FP 112, as an interval between the RP 111 held on the elevating device 117 and the FP 112 held on the conveying belt
25 108, the interval in the previous first step getter processing step is preferably maintained without change. In addition, a second getter may be given only

to the RP 111 or may be given to both of the FP 112 and the RP 111 in the similar manner as the first step getter.

5 The FP 112 to which the second step getter is given and the RP 111 positioned in the upper part of the second step getter processing chamber 105 by the elevating device 117 is lowered, thereby carrying the FP 112 and the RP 111 in the next seal processing chamber 106 without being exposed to the atmosphere.

10 In carrying in the FP 112 and the RP 111, the elevating device 117 is operated such that the spacer 115 and the envelope 113 is arranged in opposing positions until the spacer 115 and the envelope 113 contact each other while orienting the RP 111 and the FP 112 toward inside

15 which are provided with electron beam emitting devices and phosphors arranged in matrix on respective substrates.

A heating plate 125 is caused to act on the RP 111 and the FP 112 that are arranged in opposing positions

20 in the seal processing chamber 106, and if the sealing material 114 provided in advance is made of low melting point metal such as indium, the sealing material 114 is heated until the low melting point metal melts, or if the sealing material 114 is made of non-metal low

25 melting point material such as frit glass, the sealing material 114 is heated up to a temperature at which the low melting point material is affected and takes on

adhesiveness. In Fig. 1B, the temperature is set at 180°C as an example in which indium is used as the sealing material 114.

5 A vacuum degree in the seal processing chamber 106 may be set high at 1×10^{-6} Pa or more. Thus, a vacuum degree of a display panel sealed by the RP 111, the FP 112 and the envelope 113 may also be set high at 1×10^{-6} Pa or more.

10 A display panel produced in the seal processing chamber 106 is carried out to the next cool chamber 107 and cooled slowly.

The apparatus of the present invention is provided with a load lock (not shown) similar to the load lock 129 between the sealing chamber 106 and the cool chamber 107, and when the load lock is opened, a display panel is carried out of the seal processing chamber 106, the load lock is shielded after carried in the cool chamber 107, the carrying-out port 126 is opened after slow cooling, the display panel is carried out from the cool chamber 107, and lastly the carrying-out port 126 is shielded to complete all the processing. In addition, before starting the next process, inside of the cool chamber 107 is preferably set in a vacuum state by a vacuum exhaust system (not shown) that is independently disposed.

Further, according to the present invention, inert gasses such as argon gas or neon gas, or hydrogen gas

may be contained in each of the chambers 101 through 107 under depressurized condition.

Although the above-described example is a best mode, as a first variation, there is an example in which the chambers are serialized such that process proceeds in the order of preparation under the vacuum atmosphere in the front chamber 101, first getter processing in the first step getter processing chamber, heat sealing in the seal processing chamber 106 and cool processing in the cool chamber 107.

As a second variation, there is an example in which the chambers are serialized such that process proceeds in the order of preparation under the vacuum atmosphere in the front chamber 101, bake processing in the bake processing chamber 102, heat sealing in the seal processing chamber 106, and cool processing in the cool chamber 107.

As a third variation, there is an example in which the chambers are serialized such that process proceeds in the order of preparation under the vacuum atmosphere in the front chamber 101, bake processing in the bake processing chamber 102, first getter processing in the first step getter processing chamber, heat sealing in the seal processing chamber 106, and cool processing in the cool chamber 107.

As a fourth variation, there is an example in which the RP 111 and the FP 112 are conveyed by

separate conveying means.

Fig. 2 is a schematic plan view of an apparatus in which a front chamber 201, a bake processing chamber 202, a first step getter processing chamber 203, an
5 electron beam clean processing chamber 204, a second step getter processing chamber 205, a seal processing chamber 206 and a cool chamber 207 are provided around a central vacuum chamber 208 in a star arrangement. The chambers 201 through 207 are partitioned by an
10 independent chamber, respectively.

In the apparatus of Fig. 2, although a load lock 209 is provided between the front chamber 201 and the central vacuum chamber 208, similar load locks may be used for the other chambers 202 through 207 such that
15 all the chambers 201 through 207 and the central vacuum chamber 208 can be partitioned by the load locks. In addition, instead of the load lock provided between the bake processing chamber 202 and the central vacuum chamber 208, a heat shield material 210 may also be
20 used. Further, similarly, instead of the load locks provided between the other chambers 203 through 207 and the central vacuum chamber 208 respectively, heat shielding materials 210 may also be used.

In the central vacuum chamber 208, a conveying bar
25 211 is provided, on which both ends, conveying bands 213 that make the RP 111 and the FP 112 fixable by the electrostatic chuck method or the mechanical chuck

method. The conveying bands 213 are provided on a conveying bar 211 that makes the RP 111 and the FP 112 rotatable in the direction of an arrow 214, respectively.

5 By repeating carrying in and carrying out of the RP 111 and the FP 112 for each of the chambers 201 through 207 according to the movement of the conveying band 213, each processing step is applied. In applying each processing step, although all the processing steps
10 may be applied for both the substrates on the RP 111 and the FP 112, it is preferable to process predetermined step for one of both the substrates on the RP 111 and the FP 112. For example, instead of processing all the steps for both the substrates on the
15 RP 111 and the FP 112 as described above, it is also possible to carry in only the FP 112 in first step getter processing chamber 203 and the second step getter processing chamber 205, where getter processing is applied only to the FP 112, and during the
20 processing, to make the RP 111 wait in the central vacuum chamber 208, and to omit getter processing for the RP 111.

In addition, according to the present invention, inert gasses such as argon gas or neon gas, or hydrogen
25 gas may be contained in each of the chambers 201 through 207 and the central vacuum chamber 208 under depressurized condition.

Fig. 3 is a cross sectional view of an image displaying apparatus that is produced using an apparatus and a method of the present invention.

In the figure, symbols identical with those in Figs. 1A and 2 refer to identical parts. In an image displaying apparatus produced according to the apparatus and the method, a vacuum container and a decompression container are formed by the RP 111, the FP 112 and the envelope 113. In the decompression container, inert gasses such as argon gas or neon gas, or hydrogen gas may be contained under depressurized condition.

In addition, in the case of the vacuum container, a vacuum degree may be set high at 1×10^{-5} Pa or more, preferably 1×10^{-6} Pa or more.

In the vacuum container and the decompression container, the spacer 115 is provided to form an anti-atmosphere structure. The spacer 115 used in the present invention has a main body 311 made of non-alkaline insulating material such as non-alkaline glass, metal (tungsten, copper, silver, gold, molybdenum, alloy of these metals, or the like) films 308 and 310 provided on both sides of a high resistance film 309 formed of a high resistance material disposed covering the surface of the main body 311, and is electrically connected and adhered to wiring 306 via conductive adhesive. If the spacer 115 is carried in

the front chamber 101 or 201, the spacer 115 is adhesively fixed to the RP 111 on its one end in advance by low melting point adhesive 307 such as frit glass, and when the processing is completed in the seal processing chamber 106 or 206, the other end of the
5 spacer 115 and the FP 112 are electrically connected and contactingly disposed.

In the RP 111, a transparent substrate 304 made of glass or the like, a foundation film (SiO_2 , SnO_2 , etc.)
10 305 for preventing alkaline such as sodium from entering, and a plurality of electron beam emitting device 312 arranged in a XY matrix. The wiring 306 forms wiring on one cathode side of XY matrix wiring on the cathode side connected with the electron beam
15 emitting device.

In the present invention, instead of the electron beam emitting device 312 used as phosphor exciting means or an image displaying device member, a plasma generating device may be used. In using a plasma
20 generating device, inert gasses such as argon gas or neon gas, or hydrogen gas are contained in a container under depressurized condition.

In the FP 112, a transparent substrate 301 made of glass or the like, a phosphor layer 302 and an anode
25 metal (aluminum, silver, copper, etc.) film 303 connected to an anode source (not shown) are disposed.

In addition, in the present invention, when the

plasma generating device is used, a color filter can be used instead of the phosphor used as an image displaying member.

When carrying the envelope 113 in the front
5 chamber 101 or 201, the envelope 113 is adhesively fixed to the RP 111 in advance by low melting point adhesive 303 such as frit glass, and is fixedly adhered by the sealing material 114 using indium or frit glass in the processing step in the seal processing chamber
10 106 or 206.

According to the present invention, when providing the electron emitting device or the plasma generating device in the XY direction in large quantity such as 100 million pixels or more, and manufacturing an image
15 displaying apparatus on which the large quantity pixels are provided on a large screen with a diagonal size of 30 inches or more, manufacturing process time can be substantially reduced and, at the same time, a high vacuum degree of 1×10^{-6} Pa or more can be attained in
20 a vacuum container forming the image displaying apparatus.

Thus, it is seen that a method and an apparatus for manufacturing an image displaying apparatus are provided. One skilled in the art will appreciate that
25 the present invention can be practiced by other than the preferred embodiments which are presented for the purposes of illustration and not of limitation, and the

present invention is limited only by the claims which follow.

100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000